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to make the appropriate correction.

35 U.S.C. 112

Claims 2, 4, 7 and 10-18 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctively claim the subject matter which applicant regards as the invention.

Claim 2 was deleted.

Claim 4 was amended to substitute "active layer" for "active layers."

Claim 7 was amended to substitute substrate for sapphire and "from the group consisting of" for "such as"

Applicant believes that the claims as amended overcome the examiner's 35 U.S.C. 112 objections.

35 U.S.C 102(e)

Kaneko

The examiner rejected claims 1-7, 10, 14, 20 and 24-29 under 35 U.S.C. 102(e) as being clearly anticipated by Kaneko (U.S. Patent No. 6,239,901). Kaneko discloses a device that is very different from the applicant's LED and is designed to solve a very different problem.

Kaneko is directed to a light source that is based on a solid-state laser consisting of a hybrid structure that combines an excitation light source and a solid state laser. One problem with prior hybrid structures is that the emitter and solid state laser were fabricated separately and then placed in exact position relative to one another. Also, once aligned the components need to be protected from mechanical vibrations that could alter the alignment. An object of Kaneko is to provide a laser device in which the excitation source and solid-state laser are fabricated in

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the same device in precise alignment with one another.
[col. 1, lines 14-50]

The embodiment shown in FIG. 2 of Kaneko is an edge emitting light source 1 that includes a solid state laser 912 with an LED emitter on top of it. The laser 912 is formed of an Al_2O_3 crystal substrate 11 having end face mirrors 121, 122 and a bottom mirror 123. Cr^{3+} is doped in the crystal substrate 11, which acts as the solid state laser. The emitter 912 is formed from a semiconductor emitting layer 131 sandwiched between two cladding layers 132, 133. Light is generated in LED 912 by passing a current between a first electrode 141 and a second electrode 142. Light from the LED 912 passes into the optical crystal substrate 11 where it undergoes wavelength conversion. The light then reflects between the mirrors 121, 122 to produce stimulated emission of the light L_{12} through mirror 121. [col. 3, line 7 to col. 4, line 18]. Kaneko notes that although an LED is used as the light emitter, a laser can be used in its place. [col. 4, lines 43-47]. However, regardless of which light source is used, the light is first generated and then passes into the optical crystal where the mirrors cause stimulated laser emission.

The other embodiments disclosed in Kaneko essentially have the same features with small variations. For instance, the embodiment in FIG. 3 is the same as FIG. 2 except that it has top and bottom mirrors 222, 221 and the stimulated emission of light L_{22} passes from the device 2 through the bottom mirror 221. The embodiment in FIG. 4 is that same as FIG. 3 with a variation to the LED 932 on the optical crystal. A convex lens 35 is included between the LED 932 and the optical crystal. The only difference in the embodiment of FIG. 5 is that it shows a solid-state laser

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942 used in place of an LED to provide light that pumps the solid state laser 941 below it. Similarly, the embodiment shown in FIG. 7 uses a laser emitter 962 that is arranged in a notch in the optical crystal 61. The optical crystal 61 between mirrors 622 and 621 functions as the laser crystal causing stimulated emission from mirror 621. The embodiments in FIGs. 8, 9 and 10 provide variations of the light emitter in FIG. 7.

All of the embodiments have one feature in common, they all rely on a light source applied to an optical crystal, which serves as a solid state laser. The optical crystal contains material that wavelength converts the light before it is emitted as a stimulated laser light through one of the mirrors. Even Kaneko's independent claim 1, from which all other claims depend, requires that the light source have mirrors.

Applicants' invention is quite different and addresses a different problem. Applicant's LED is designed to overcome the problem's associated with generating difference colors from LED's made from the nitride based material system (although it is equally applicable to LEDs from other material systems). The LED is grown on a substrate that can be doped with certain elements whose electrons are pumped to a higher energy state by the light from the LED's active layer. The electrons then return to their natural energy state and emit light at a wavelength that is different from the LED's active layer. The LED then emits both the light from its active layer and from the dopants. Depending on the light from the active layer and the type of dopant in the substrate, the LED will emit a different color of light.

Applicants' light source does not use an LED or laser emitter to pump a solid state laser that may have materials

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to change the wavelength of light. Further, applicants' light source does not use mirrors to generate laser stimulated emission.

To further distinguish these differences applicant amended claim 1 so that it is now directed to a LED with an active layer surrounded by a pair of oppositely doped layers on opposite sides of said active layer. The doped layers cause the active layer to emit light at a predetermined wavelength. All of these layers are formed on a doped substrate such that said substrate absorbs at least some of said light from said active layer and re-emits light at a different wavelength. The LED then emits a combination of light from said substrate and said active layer. Claim 25 was similarly amended to so that it is now directed to a LED with the light from the LED being a combination of the light from the LED's active layer and doped semiconductor material.

Kaneko does not disclose, teach or suggest using an this arrangement. Instead, Kaneko focuses on using a light source to pump a solid state laser, which includes and optical crystal and mirrors. Applicants' respectfully submit that claim 1 and 25 are now patentable over Kaneko. Claims 2-7, 10, 14, 20 and 24 depend from allowable claim 1 and are also allowable, and claims 26-29 depend from claim 25 and are now allowable.

Birkhahn

Claims 25-29 were rejected under 35 U.S.C. 102(e) as being anticipate by Birkhahn et al. (U.S. Patent No. 6,255,669). Birkhahn discloses a wide bandgap semiconductor material formed on a substrate, with the semiconductor material being doped with an effective amount of a rare earth element. The substrate can be any commonly used

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substrate such as silicon, silica, sapphire, metals, ceramics and insulators. [col. 2, lines 1-8].

Claim 25 as amended applies to an LED with an active layer on a doped substrate, with the LED emitting a combination of light from its active layer and substrate. Birkhahn does not disclose, teach or suggest an LED fabricated on a doped substrate or an LED emitting a combination of light from the substrate and active layer.

Applicant respectfully submits that claim 25 as amended is allowable over Birkhahn. Claims 26-29 depend from allowable claim 25 and are also allowable.

Russel

Claims 25-29 were also rejected as being anticipated by Russel et al. (U.S. Patent No. 6,093,941). Russel discloses a photonic structure comprising a transparent substrate and a layer of group IV semiconductor material formed on the transparent substrate. The substrate has a region for emitting light that is porous and has a lower density than the rest of the substrate.

As noted by the examiner, Russel does not set forth that the emitter includes clad layers. Accordingly, claim 25 as amended is directed to an LED with an active layer surrounded by a pair of doped (clad) layers. Claim 25 is now allowable over Russell and claims 26-29 are allowable as depending from claim 25.

35 U.S.C 103(a)

The examiner rejected claims 8, 9, 11-13, 16-18, 21 and 22 under 35 U.S.C. 103(a) as being obvious over Kaneko. As outlined above, claim 1 has been amended so that it is directed to a light emitting diode, which emits light that is a combination of light from its active layer and its

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doped substrate. Kaneko does not disclose, teach or suggest this combination and claim 1 is patentable over Kaneko. The rejected claims herein depend from claim 1 and are also allowable.

Claim 15 was rejected under 35 U.S.C. 103(a) as being unpatentable over Kaneko as applied to the claims above in view of Birkhahn. Claim 15 also allowable as depending from allowable claim 1. Further, the examiner found that Birkhahn teaches that wide band gap semiconductor substrates doped with elements with partially filled inner shells, such as rare earth elements and transition metals can be formed and will emit in the visible and UV spectrum at a wide range of temperatures. Applicants' respectfully submit that Birkhahn does not include this disclosure. As mentioned above, Birkhahn discloses a light emitting device wherein, a wide band gap semiconductor material is formed on a substrate with the semiconductor material being doped with a rare earth element. The substrate is any commonly used substrate. [col. 2, lines 1-8].

Claim 19 and claim 23 were also rejected under 35 U.S.C. 103(a) as being unpatentable over Kaneko, with the rejection of claim 19 being in view of the admitted prior art. These claims depend from allowable claim 1 and are also allowable.

Claims 10-13, 17, 19 and 20-23 were deleted to as a result of the amendment to claim 1 wherein the LED has an active layer.

Claims 30-47 were added to include an embodiment of applicant's invention wherein the light source has multiple active layers that can simultaneously or selectively emit light. None of the references disclose, teach or suggest using a light source with multiple active layers, with the

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light from the active layers pumping dopants in a substrate to generate light as a different wavelength. Support for these claims can be found in FIGs. 2-6, throughout the detailed the specification and in the claims as originally filed.


Claims 47-51 were added as a result of canceling claims 20-23, which were directed to a solid state laser. None of the references disclose, teach or suggest using a solid state laser that is structurally similar to an LED. Support for these claims can be found in FIGs. 7 and 8, in the specification page 14, line 17 to page 15, line 30 and in the claims as originally filed.

All of the claims in the application are now believed to be in proper form for allowance, and a Notice of Allowance is respectfully requested.

A petition for a one month extension of time to file this response is filed concurrently.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. (Amended) A solid state light emitting device, comprising:
 - a light emitting diode (LED), including:
 - an active layer;
 - a pair of oppositely doped layers on opposite sides of said active layer which cause said active layer to emit light at a predetermined wavelength in response to an electrical bias across said doped layers; and
 - a doped substrate, said active and doped layers disposed successively on said substrate such that said substrate absorbs at least some of said light from said active layer and re-emits light at a different wavelength, said LED emitting a combination of light from said substrate and said active layer.
4. (Amended) The light emitting device of claim 1, wherein said active [layers are] layer includes multiple quantum wells, single quantum wells or double heterostructure.
7. (Amended) The light emitting device of claim 1, wherein said [sapphire] substrate is doped with at least one impurity [such as] from the group consisting of chromium, titanium, iron, erbium, neodymium, praseodymium, europium, thulium, ytterbium [or] and cerium.
8. (Amended) The light emitting device of claim 1, [comprising a light emitting diode (LED),] wherein said active layer [emitting] emits UV light and said substrate

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comprises sapphire doped with chromium, said substrate absorbing some of said UV light and re-emitting red light.

9. (Amended) The light emitting device of claim 1, [comprising a LED,] wherein said active layer [emitting] emits yellow light and said substrate comprises sapphire doped with chromium, said substrate absorbing some of said yellow light and re-emitting red light.

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~~10. (Amended) The light emitting device of claim [2] 1, wherein the light emitting from said device comprises the light emitting from [at least one of] said active [layers or the light emitting from at least one of said active layers] layer in combination with the light emitted from said doped substrate.~~

14. (Amended) The light emitting device of claim [2] 1, [comprising a LED,] wherein said active layer [emitting] emits one color of light, said substrate doped throughout with more than one impurity such that [said] it absorbs the light of said active [layers, light] layer and [re-emit] re-emits more than one color of light.

15. (Amended) The light emitting device of claim [2] 1, [comprising a LED with at least one] wherein said active layer [emitting] emits UV light and said substrate is doped throughout with chromium, titanium, [iron,] and cobalt, said doped substrate [absorbs] absorbing said UV light and [emits] emitting red, green, and blue light.

16. (Amended) The light emitting device of claim 2, [comprising an LED with at least one] wherein said active layer [emitting] emits UV light, and said substrate is

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doped by one or more rare earth or transition element in separate color centers that absorb UV light and re-emit a different color of light, said bias selectively applied to a portion of said active [layers] layer above said color centers causing said active [layers] layer to emit light that will be primarily absorbed by said color center below said selectively biased portion of said active [layers] layer and re-emitted as a different color.

18. (Amended) The light emitting device of claim [17] 1, wherein said active [layers] layer emits UV light, and said substrate doped by one or more rare earth or transition element in separate color centers, each said color center absorbs UV light and re-emits it as a different color.

25. (Amended) A method for generating light from a solid state light emitting device, comprising:

providing a light emitting diode having an active layer surrounded by a pair of oppositely doped layer, all of which are disposed on a doped substrate;

exciting an optical emission from said active layer within a first wavelength range;

applying at least a portion of said optical emission to stimulate emission from said doped [semiconductor material] substrate within a different wavelength range; and

transmitting a combination of said optical emission and substrate emission [both emissions] as said LED's light.

26. (Amended) The method of claim 25, wherein said doped [semiconductor material] substrate comprises sapphire, spinel, silicon carbide, gallium nitride, quartz YAGI,

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garnet, lithium gallate, lithium niobate, zinc oxide, or oxide single crystal.

27. (Amended) The method of claim 25, wherein said [semiconductor material] substrate is doped with at least one rare earth or transition element.

28. (Amended) The method of claim 25, wherein said [semiconductor material] substrate is doped with at least one impurity from the group consisting of chromium, titanium, iron, erbium, neodymium, praseodymium, europium, thulium, ytterbium and/or cerium.